A NEW SUBSPECIES OF COENONYMPHA NIPISIQUIT McDUNNOUGH FROM NEW YORK STATE

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The addition of a resident species to the butterfly fauna of a state so well known as New York is an uncommon event. The discovery of *Coenonympha nipisiquit* McDunnough, a member of the superspecies *tullia* Muller, on the islands in the St. Lawrence River off Clayton, New York, took place accidentally. I was visiting Mr. Bernard Heineman at his summer home on Picton Island to discuss with him the joint preparation of a book about Jamaican Butterflies. On Wednesday, August 21, 1957, Dr. William Creighton, an old friend, joined us and we toured the island to see the quarries, several of which supplied the granite that was used to build the original parts of the American Museum of Natural History. Picton Island is bilobed, the southern portion being composed of Potsdam Sandstone and the northern portion of Picton Granite. The lowland that connects the two parts is invaded from the northeast by several acres of marsh. Returning from our tour of the southern lobe of the island as we approached the connecting lowland a small dark butterfly started up from the path at my feet. My first reaction was that it was a Hair-streak but as it settled I saw at once that it was *Coenonympha.* Neither Creighton nor I had a net with us but Heineman was carrying one to collect Monarchs for an experiment relative to their acceptability as food by red squirrels. While Creighton and I herded the butterfly in a limited area the net was brought and the specimen captured. The butterfly proved to be a fresh male *Coenonympha* somewhat like *inornata* but much darker and somewhat smaller.

My first thoughts were that the insect was either a case of very late emergence or a rare example of a partial second brood such as has been observed upon one or two occasions with *inornata.* It then dawned upon me that this was the first capture of the species in New York State if not in the northeastern part of the United States. The next morning Heineman and I prowled the marshy area referred to above for an hour or so and turned up another male, somewhat more worn than the first but obviously not a hanger-on from a spring brood. The next day we visited a friend of the Heinemans on near-by Grindstone Island, a much larger island than Picton. As we were about to return to Picton, Heineman saw another *Coenonympha* start up from the garden and fly out into a field. We had no nets and could not catch it. We returned to Grindstone that afternoon and headed for the marshes that almost cut the island through, just west of the Bentzen Farm. There we found *Coenonympha* to be abundant and in about an hour, from 2:30 to 3:30 p.m. captured over thirty specimens, most of them fresh males. Heineman returned on the 23rd and 30th seeking gravid females and picked up a few more specimens.

This array has allowed me to reach certain interesting conclusions. These Thousand Islands *Coenonympha* are different from any *inornata* with which I am familiar. They are marsh butterflies, usually weaving back and forth over the perimeter of the marsh and the adjacent dry grasslands. Whether or not they actually breed in the marsh is yet to be explored. When disturbed by an unsuccessful sweep of the net they head into the marsh for security. As is usual with these insects the flight is low, rarely does an individual rise to as much as three feet from the ground. Their more rapid darting flight when compared with the flight of *inornata* may be due entirely to the heat of August in the early afternoon. Colorwise they are darker than any strain of *tullia* from North America except *macissaci* Dos Passos, the strain found on Newfoundland. They differ from that butterfly in the quality of color, being redder and more like *nipisiquit* McDunnough from Bathurst, New Brunswick. The Thousand Islands insect and *nipisiquit* are the only strains in North America that are associated with a hardwood or slightly mixed forest rather than a coniferous forest. According to the map that accompanies Halliday's (1937) report on Canadian forests, Picton and Grindstone Islands lie in the Upper St. Lawrence Section of the Great Lakes—St. Lawrence Forest Region. Bathurst lies at the junction of the Temiscouata-Restigouche Section of the same forest region and the Mirimiche Section of the Acadian Forest Region. The various sections of these forest regions are clearly defined on pp. 29–39 of Halliday's paper.

Essentially there is a little more boreal element at Bathurst than there is on the islands.

The Thousand Islands strain of *tullia* is far more prone to show ocelli, or at least traces of them, on the under side of the hind wings than any other eastern strain of *tullia.* Like *nipisiquit* the newly discovered butterfly seems to be a summer butterfly, not a spring one. This is more important than it seems at first. Both are at the extreme southern border of the distribution of the species in the eastern part of North America and under such conditions one would look for a somewhat earlier emergence than farther north. Thus if the North American *tullia* are treated as several species instead of subspecies of an holarctic insect the new subspecies must be considered a subspecies of *nipisiquit* and not of geographically closer *inornata.* It has in common with the former, late appearance, marsh habitat and redder coloring. It differs from *nipisiquit* in its smaller size and the great degree in which the ocelli are present.

In my study of these insects (1955) I considered *nipisiquit* a subspecies of *inornata.* I expressed (p. 375) some concern about the ability of *nipisiquit* to withstand the climate of its range and said "Thus in search of the coolest areas *nipisiquit* crowded into the sea marshes where the cooling effect of the sea is most felt during warm summer months." Apparently this can be said for the Thousand Islands strain. The discovery of this second peripheral strain of *tullia* has fortified for me a part of the original manuscript that I did not publish in 1955. At that time I was not convinced that I was right since no evidence was at hand to show a relative of *nipisiquit* at the northern end of the Hudson Valley—Lake Champlain gateway to the north. My theory required that such a strain should exist to-day or in post-Wisconsin time. Now I am willing to set forth my ideas.

I visualize a pre-Wisconsin, Sangamon Interglacial period, distribution of *Coenonympha tullia* in eastern North America about the same as we know the distribution to be today. I imagine the insect of that period to be much like the strains found along the eastern front of the Rocky Mountains from northern New Mexico to northern Wyoming, weakly ocellate. The color difference that exists today between eastern and western strains I believe existed then and for the same reasons (*l.c.* 396–397), relative humidity. As the ice of the Wisconsin glacial period began to extend southward the insects in question slowly retreated before it. The great mass moved down the Mississippi valley and found refuge possibly as far south as the latitude of northern Texas where paleobotanical studies tell us there was a forest similar to that in which the eastern strains of *tullia* thrive today. A lesser mass moved southward through the valley of the Hudson River and other more eastern river valleys onto the Atlantic coastal plain. This flow probably terminated somewhere in the Carolinas.

The *tullia* that waited out the Wisconsin ice age in the lower Mississippi valley were subjected to about the same climatic regime that they had experienced in their old, and present, homeland. The one great difference was the difference in the length of daylight throughout the year, shorter in summer and longer in winter. Something, either the change in daylight or the rigors of the long trek to and fro, eliminated from their complex of genes those that are responsible for ocelli. Those that were forced into the Atlantic coastal plain met with a different climate from that to which they had been accustomed. They were subjected to a maritime climate more equable than that enjoyed by their ancestors. They too suffered a change in daylight. Somehow the changes made it advantageous to emerge later in the year. Thus over the millenia spent in the southern refugia a spring butterfly changed to a summer one. With the retreat of the Wisconsin ice, beginning about 11,000 years ago, these butterflies slowly moved northward always staying in the ecological niches for which they were best fitted. New characters that had been gained during the period of refuge in the south were not all lost but only those that benefited the northward moving insects and those that had no effect upon survival have survived to today.

The Appalachian ranges separated the two diverging sets of strains during the Wisconsin period. As the northward movement took place these mountains channeled the homeward routes. The butterflies from the Mississippian refugia probably entered their present range over the prairies west of the Great Lakes and possibly the northern peninsula of Michigan. The butterflies from the Atlantic coastal refugia pressed northward east of the mountains. Some took a purely coastal route moving from salt marsh to salt marsh to terminate in New Brunswick as *nipisiquit*.

Others broke through the mountain barrier by way of the river valleys. The stream that moved up the Hudson Valley gave rise to the Thousand Islands strain. Apparently the seeds for the difference between *nipisiquit* and the New York strain were planted during the Wisconsin period. One strain had become adapted to the conditions of salt marshes, the other to those of fresh water marshes. The latter seems to have retained in its constitution more of the genes responsible for producing ocelli than any other strain east of the Rocky Mountains.

I take great pleasure in dedicating this interesting new subspecies to my good friend, Mr. Bernard Heineman of New York City.

Coenonympha nipisiquit heinemani n. ssp.

MALES. The color and shading of the upper side of the males of *heinemani* are very much like those of *nipisiquit.* The ground color is deep brown tinged with reddish. The wings are broadly washed with smoky brown along the outer margins, especially on the hind wings where the smoky color may cover the entire wing. Just within the margin of the hind wing of most specimens there is a dark brown narrow zig-zag line or row of chevrons. The fringes are greyer than the wings, especially at the abdominal angle of the hind wings. In this respect *heinemani* differs from *nipisiquit* upon which the fringes are almost concolorous with the wings. Almost invariably the apex of the fore wing bears a black dot or spot in the usual position for the apical ocellus, thus differing from *nipisiquit, inornata* and *macissaci.* Usually this black mark is circled by a ring of deep brown free of any smoky overtones.

On the under side of the fore wing the ground color is of the same quality as on the upper side but of a little lighter shade. The apex and a tapering zone along the outer margin are both heavily washed with white or slightly yellowish scales. This gives a definitely yellow-greenish tone to these areas of fresh specimens and a salt-and-pepper appearance to others. In it is a well-developed apical ocellus, universally present and composed of a black iris with white pupil and ringed with yellow. The sinuous line that lies between the ocellus and the end of the cell usually extends at least as far as Cu_1. It is black outwardly shaded with white. Occasionally there are supernumerary ocelli represented by black dots in spaces M_3 and Cu_1. The hind wing has the basal half much darker than the outer half and darker than the disc of the fore wing. It is heavily powdered with light scales which are more densely set in the outer half than the basal half. The sinuous junction between the inner and outer portions of the wing usually is well defined. Very rarely there is a light patch at the base of the wing, a character usually found only on *ochracea* and its allies in the western states. Frequently there are one or more white or black points in the submargin representing the ocelli found similarly placed on western subspecies. The frequency with which these spots appear immediately sets *heinemani* apart from the other eastern subspecies.

FEMALES. The upper side of specimens of this sex is much lighter than that of the males. The ground color is ochre-brown, about the same as on *nipisiquit* and darker than on either *inornata* or the few *macissaci* females before me. There is very little of the smoky overtones along the margins in specimens of this sex. The fringe is somewhat yellower than on the males and in less contrast with the ground color of the wings. The location of the apical ocellus always is marked by a black dot or spot. Occasionally there are tiny black dots in spaces M_3 and Cu_1.

The under side is much lighter than that of the male, light brown-ochre. Otherwise the two sexes are marked alike. The apical ocellus on the fore wing is fully developed on all of the specimens I have seen. Supernumerary ocelli on the fore wing are more frequent on the females than on the males and some of these are true ocelli not just black dots marking the positions of ocelli. Over half of the specimens examined bear indications of ocelli in the submargin of the hind wing. None showed any sign of a basal light patch.

The one characteristic that sets *heinemani* apart from all other eastern *Coenonympha* is the high frequency with which supernumerary ocelli are found on the under side of the fore wing of both sexes, and the frequency with which ocelli or representative points are found in the submargin of the same side of the hind wings of both sexes.

Holotype: a male, Grindstone Island, Clayton, Jefferson Co., New York, Aug. 22, 1957, collected by F. M. Brown.

Allotype: a female, the same data as the holotype.

Paratypes: 1–18, males with the same data as the holotype; 19–23, males with the same data as the holotype but collected by Heineman; 24–28, males from Grindstone Island collected on Aug. 23, 1957 by Heineman; 29–31, males from Grindstone Island collected Aug. 30, 1957 by Heineman; 32, a male from Picton Island collected Aug. 21, 1957 by Brown; 33, a male collected on Picton Island Aug. 22, 1957 by Brown: 34–36, females with the same data as the allotype; 37–40 females with the same data as the allotype but collected by Heineman; 41, a female collected on Grindstone Island Aug. 23, 1957 by Heineman; 42–44, females collected on Grindstone Island Aug. 30, 1957 by Heineman.

The holotype, allotype and the paratypes collected by Brown, except number 33, have been deposited at the American Museum of Natural History. Paratype 33 is in the Heineman Collection.

The data for *nipisiquit* and for *inornata* were taken from Brown, 1955, pp. 375 and 382–385. The "error" for each

Statistics of variation for several strains of *Coenonympha tullia*.

MALES

	nipisiquit	*heinemani*	*inornata*
Number studied	141	34	66
Size, radius of left fore wing, mm.	18.76 ± 0.61	16.30 ± 0.83	17.60 ± 0.62
Coefficient of variation	3.3	5.1	3.5
Forewing, upper side			
Presence of ocellus or trace, %	12.0 ± 2.7	91.2 ± 4.8	6.1 ± 2.9
Fore wing, under side			
Presence of ocellus or trace, %	82.2 ± 3.2	100	54.6 ± 6.2
Supernumerary ocelli or traces, %	0.0	29.4 ± 7.8	0.0
Ray absent, %	0.0	2.9 ± 2.2	0.0
Ray ends at M_3, %	0.7 ± 0.5	0.0	0.0
Ray ends at Cu_1, %	47.5 ± 4.2	41.2 ± 8.4	13.6 ± 4.2
Ray reaches or exceeds Cu_2, %	51.8 ± 4.2	55.9 ± 8.5	86.4 ± 4.2
Hind wing, under side			
Ray complete, %	6.4 ± 2.1	52.9 ± 8.5	10.6 ± 3.8
Ray broken, %	83.7 ± 3.1	41.2 ± 8.4	63.6 ± 5.9
Ray ends at M_3, %	4.2 ± 1.7	5.9 ± 4.7	22.8 ± 5.2
Ray fragmentary, %	5.7 ± 2.0	0.0	3.0 ± 2.1
Submarginal marks absent, %	40.0 ± 4.1	100	48.5 ± 6.1
Ocelli or traces present, %	0.0	50.0 ± 8.6	0.0
Basal light patch present, %	0.0	2.9 ± 2.2	0.0

FEMALES

	nipisiquit	*heinemani*	*inornata*
Number studied	64	11	10–11
Size, radius of left fore wing, mm.	18.86 ± 0.58	16.79 ± 0.65	17.69 ± 0.63
Coefficient of variation	3.1	3.9	3.6
Fore wing, upper side			
Presence of ocellus or trace, %	57.7 ± 6.2	100	63.7 ± 14.5
Fore wing, under side			
Presence of ocellus or trace, %	95.3 ± 2.6	100	72.7 ± 13.5
Supernumerary ocelli or traces, %	0.0	63.7 ± 14.5	0.0
Ray ends at M_3, %	0.0	9.1 ± 8.6	0.0
Ray ends at Cu_1, %	9.4 ± 3.6	36.4 ± 14.5	20.0 ± 12.5
Ray reaches or exceeds Cu_2, %	90.4 – 3.6	45.5 ± 15.0	80.0 ± 12.6
Hind wing, under side			
Ray complete, %	14.1 ± 4.4	63.7 ± 14.5	60.0 ± 15.0
Ray broken, %	84.4 ± 4.5	27.3 ± 13.5	40.0 ± 15.0
Ray ends at M_3, %	1.6 ± 1.6	9.1 ± 8.6	0.0
Submarginal marks absent, %	62.5 ± 6.0	100	20.0 ± 12.6
Ocelli or traces present, %	0.0	63.7 ± 14.5	0.0
Basal light patch present, %	0.0	0.0	0.0

measurement is its standard deviation. This was determined for the per cent by extracting the square root of the product of npq, where n is the number of cases, p the decimal frequency of occurrence and q is $1.00-p$. The data for the males are based upon sufficiently long series to have meaning. Those for the females of *heinemani* and *inornata* are best considered no more than trends unless the frequency is greater than 40 per cent.

NOTES ON IMMATURE STAGES

On August 30 Heineman returned to Grindstone Island and collected several gravid females. These he enclosed over lawn grass with a little sweetened water. After three days of inactivity one (?) of the females laid five eggs on September 2. A week later when no more eggs had been laid Heineman sent me the five by airmail. They arrived in Colorado Springs on September 12.

EGG. When received, ten days after they had been laid, the five eggs were pale straw colored and lightly mottled with reddish brown blotches. Less area was covered by the dark color than the light. Structurally they seemed to me to be inseparable from the eggs of other North American *tullia*. The diameter measured with an eye-piece micrometer at 14 diameters magnification was 0.75 mm. and the height 0.71 mm. The eggs hatched on September 18.

FIRST INSTAR LARVA. Upon emergence three of the five larvae ate the egg shell from which they had escaped, the others made no attempt to do so. The larvae are elongate conical in shape, tapering rather abruptly from the large head through the thoracic segments and less pronouncedly through the abdominal segements. The head is pale brown and finely granulate. The thorax and abdomen are white with a mid-dorsal and two lateral bands of pale reddish brown. Between the two lateral stripes is a third broken stripe of the same color. Pendant from the lower of the two solid stripes are lobes of reddish brown that include the spiracles. The caudal tabs are yellow-ochre. This is somewhat different from the excellent drawings of first instar larvae of *californica* published by Edwards (1897) and Davenport's description of the same stage of *inornata*. The surface of the larva is densely studded with minute tubercles each bearing one or more very fine colorless hairs that are clubbed at the tip. These hairs are visible only under considerable magnification and with proper lighting. There are similar hairs on the head. Initial length is 1.65 mm., transverse diameter of the head is 0.52 mm., and length of the head 0.26 mm. I could not measure the vertical depth of the head on these larvae, they were too lively in the warmth of the lamp. It seemed to be a little greater than the transverse diameter.

None of the larvae made any attempt to eat the fresh lawn grass that I supplied during the first days out of the egg. They were very sluggish and hardly moved from day to day. Several days after emergence one of them while being watched through a binocular microscope seemed particularly lively in the warmth of the lamp light. As I watched, it essayed a bite at the edge of a grass blade. This larva then began to feed regularly but very sparingly. Each morning fresh food was supplied and no more than three or four millimeters had been nibbled along the edge of a blade of grass during the previous twenty-four hours. On the morning of October 3 I found that it had passed its first moult.

SECOND INSTAR LARVA: Total length at beginning of instar was 2.95 mm. I could see no marked difference in the appearance after this moult. These changes had taken place: the color became somewhat greenish, the reddish brown stripes perhaps a little darker and the hairs perhaps a little longer.

A bout with influenza confined me to bed for about ten days soon after these observations had been made. When I returned to my laboratory the vial containing the second instar larva showed moulded grass and a dead caterpillar. The other four larvae were still healthy. They had made no attempt to feed and now are buried beneath leaves in the grass at the north side of the laboratory to await spring. Whether they will survive Colorado's erratic winter weather and desiccating air is questionable.*

In latitudes somewhat north of Grindstone Island *inornata* begins its hibernation while the weather is still warm and when the larvae are in the fourth instar. It seems quite probable that *heinemani* passes the winter as a first instar larva. This is in keeping with what we suspect of the behavior of *nipisiquit*.

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* They did not survive.

EXPLANATIONS OF PLATE II

Figs. 1–10. **Coenonympha nipisiquit heinemani** Brown. 1. Holotype, male, Grindstone Island, Clayton, New York, August 22, 1957, collection Brown, upper side. 2. Holotype, under side. 3. Allotype, female, same data, upper side. 4. Allotype, under side. 5–7. Paratypes, males, same data, showing variations in development of ocelli and basal light patch on hind wing. 8. Paratype, male, Grindstone Island, Clayton, New York, August 30, 1957, collection Heineman, showing dark submarginal row of "chevrons" on hind wing. 9–10. Paratype, female, Grindstone Island, Clayton, New York, August 30, 1957, collection Heineman, light colored with well developed supernumerary ocelli.

Fig. 11. Egg. 12–14. First instar larvae, about 24 hours old.

Figs. 1–10. Three-quarters natural size. Figs. 11–14. Magnified approximately 20 diameters.